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Experiments to synthesize soft-sedimentary deformation and clastic dikes

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ABSTRACT

Clastic dikes are intrusions of sediments into layers of other sedimentary strata that are found in various places across eastern Washington. Three notable sites include Burlingame Canyon in Touchet, WA, Tucannon Valley near Starbuck, WA and Campion Park in Spokane, WA. Clastic dikes are thought to be formed by either overburden stress or from seismic activity. In eastern WA, the dikes were formed by large overburden pressure and seismic-like forces caused by cataclysmic floods that washed over eastern WA (known as the Missoula floods). We recreated this environment by layering saturated sand below and on top of kaolinite clay, and hitting the surface of the layered, saturated sediment with a rock hammer, about 700 kg/cm2. This was able to show the air bubbles escaping the softer sediments, and pulling the clay up to fill in the trail left by the air bubbles and initiated the intrusion of sand into the clay causing the formation of a clastic dike. We were able to differentiate between linear dikes (one main trunk) and branching dikes (multiple splits from the trunk), and by extrusion (coming from the bottom and moving upward) and injection (infilling from the top). Laboratory experiments produced similar features and highlighted the importance of saturation of sediments and bubble transport of sediments to cause clastic dikes.

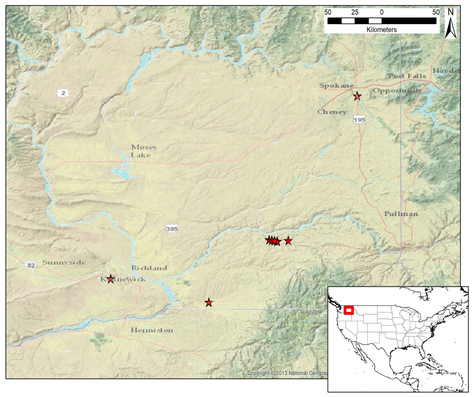


Fig 1: Map of known sites of clastic dikes

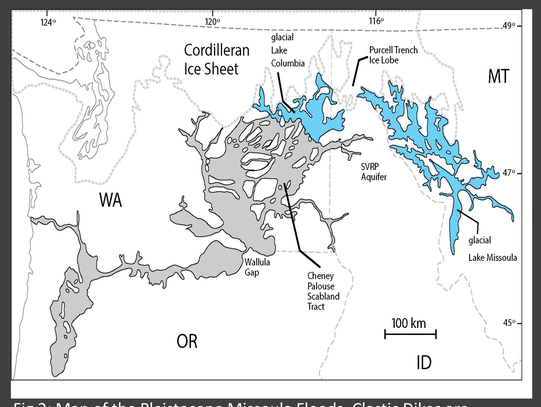


Fig 2: Map of the Pleistocene Missoula Floods. Clastic Dikes are commonly associated with fine-grained deposits from periodic ponded lakes, like glacial lake Columbia or glacial Lake Lewis in the Tri-Cities area.

Fig 3: Sugtrusion Model

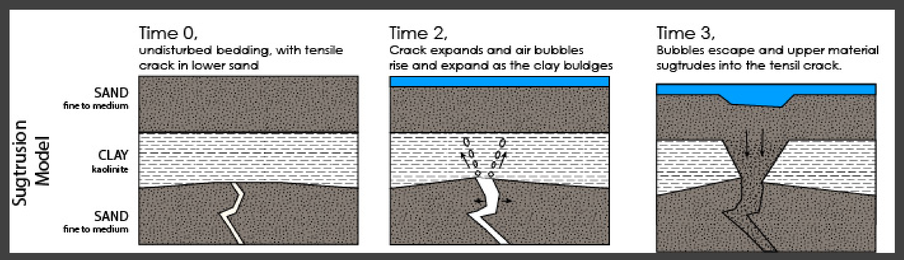


Fig 4: Experiment One:

In experiment 1, we have slow overburden pressure and saturated sediments. Overburden pressure allowed for grain rotation and the formation of a bubble train. The bubble train escapes to the surface to create an empty cast. This is then back filled by the previous sediment, creating a sugtrusive dike.

Fig 5: Extrusion Model

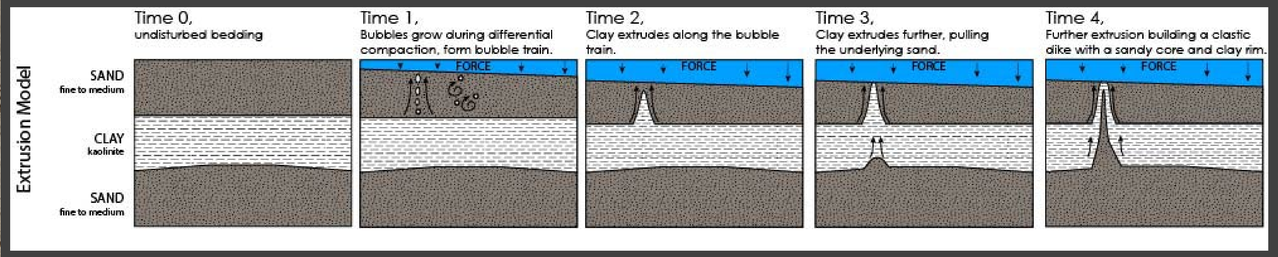
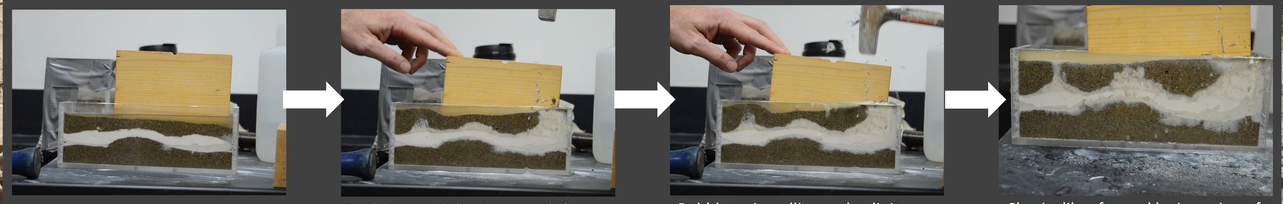


Fig 6: Experiment Two



Undisturbed, saturated bedding

Bubble growth beginning in left side of cross bedding

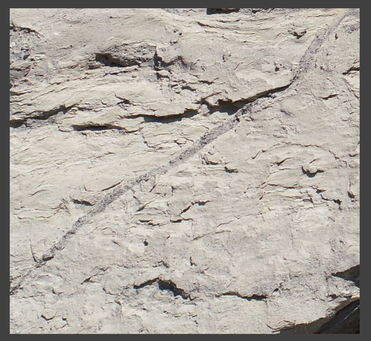
Bubble train pulling up kaolinite clay as it escapes the layers

Clastic dikes formed by intrusion of sediments from lower layers of strata.

Fig 7: Types of clastic dikes in the field

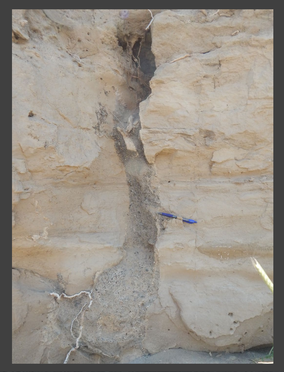
Sugtrusive dike in Tucannon Valley

Linear dike in Tucannon Valley



Branching dike in Tucannon Valley

Linear, injection dike in Tucannon Valley



Fault injection dike in Kennewick

Extrusive dike in Tucannon Valley

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